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ABSTRACT

This study sought to develop and validate a programed instructional system to improve question-generating behavior in elementary school children in order to enhance reading comprehension. Materials were tested with individuals, groups, and entire classrooms; each tryout was followed by program revisions. Both criterion-referenced and standardized reading-comprehension tests were used to evaluate program effectiveness. Results indicated that the program did produce a question-asking set in children and that it improved reading comprehension as measured by scores on the standardized test. (Author/AA)

# LEARNING TO ASK QUESTIONS

by
Ruth Cohen

## ABSTRACT

Two problems have been addressed: 1) whether it is possible to build a question asking set in children, and 2) whether the acquisition of a question asking set will enhance reading comprehension.

The objective was the development and validation of an instructional system for ensuring question generating behavior in elementary school children.

The program was tested with individuals, groups, and entire classrooms; each tryout was followed by intermediate program revisions.

Both criterion--referenced and standardized reading comprehension tests were used to evaluate the program effectiveness.

The results indicate that it is possible to build a question asking set in children. The significant gains of the experimental groups on the standardized subtest demonstrate that training in question generating can enhance comprehension. In order to correctly respond to the standardized subtest, the student had to generate questions at various levels of complexity. The fact that the performance of the experimental groups on the standardized subtest improved significantly may indicate that since the children were trained to respond at lower levels, they were capable of responding to the constraints of higher level skills.

# LEARNING TO ASK QUESTIONS

A research report

by

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# CHAPTER 1

## THE PROBLEM

### Introduction

Many educators agree that developing questioning skills is an essential part of the educational process. (Firch, 1880; Dale, 1968; Brethower, 1969; Stauffer, 1968). As Joshua G. Firch wrote a century ago:

> "The whole sum of what may be said about questioning is comprised in this: it ought to set the learners thinking, to promote activity and energy on their parts, and to arouse the whole mental faculty into action, instead of blindly cultivating the memory at the expense of higher intellectual powers." (Firch, 1880, p. 1)

A similar view was expressed by Dale:

> "Schools do not usually teach the art of questioning, but expect students to develop skills in answering questions that they did not ask. We need to help students to ask better questions... Education cannot be made interesting and effective unless students keep asking What? Why? and How? and they are encouraged and assisted to find good answers to their questions." (Dale, 1968, p. 1)

Despite such agreement and the apparent absence of disagreement, only incidental data is available to verify the importance of questions for learning. Rothkopf (1966), Rothkopf and Bisbicos (1967), and Frase (1967) studied the effect of question placement on learning. In these several studies, groups who saw a question either before or after the reading passage retained significantly more information than did control groups who did not see questions at all. In none of these studies were students required to generate their own questions.

If question-asking is a skill, then it should be amenable to instruction. Therefore, we may ask:

1. Whether it is possible to build a question asking set in children.

2. Whether the acquisition of a question asking set will have an effect on reading comprehension.

In order to build a question asking set in elementary school students, one will have to train children in the asking of appropriate kinds of questions. In addition, children must be trained to modify their questions to fit text material; they must reformulate questions while they read. In other words, children must be able to:

1. Transform statements into questions.

2. Initiate reading with a set of questions, then reformulate the questions on the basis of textual constraints.

Literature Review

The literature on questioning in reading may be grouped under two major headings: (1) characteristics of questions which influence learning; (2) definitions of reading comprehension.

1. Characteristics of Questions Which Influence Learning

Two characteristics of questions have been of interest to investigators: (a) the type of question; (b) its position in the text.

a. The Type of Questions Asked

Studies by Frase (1968), Rothkopf and Bisbicos (1967), and Morasky (1970), have indicated that short term retention of both relevant and incidental information was higher with specific questions than with general questions.

Morasky (1970) studied the effect of open-ended (general) questions on incidental and relevant learning from written materials; no significant difference occurred between mean recall scores for incidental and relevant questions. Morasky interpreted this result in the following way:

> "...More important perhaps is the possibility that subjects not only do not make an overt response to open-ended questions, but that they might not even make a covert response. Such a situation would mean that an hypothetical answer could not be generated...Without a...hypothetical answer in storage, the subject could not efficiently use a matching strategy...An alternative...strategy would be one in which the subject attempted massive storage of information...This is similar to what a subject attempts when questions are not used with written material." (Morasky, 1970, p. 10)

Other than studies of specificity-generality of questions, little research has been done concerning the effect of types of questions on reading comprehension.

Watts and Anderson (1971) (as cited in Anderson 1972) argued that inserted questions which required comprehension would induce meaningful processing of text, and thus, improve performance on new criterion test comprehension questions. High school seniors answered a question after reading each of five passages explaining a psychological principle. This study has shown that groups which received inserted questions requiring them to apply the principles to new examples performed significantly better on the post-test than did all other groups, including groups which received inserted questions that repeated examples described in the text. The group which answered verbatim name questions performed worst on the post-test, poorer even than the reading only control group. A possible explanation of improved performance on new questions for the first groups is that a question which follows a paragraph may influence information processing skills on the passage which follows it; it may contain a hint of what category of question will be asked following the next passage and hence, will elicit the appropriate processing skills. Thus, answering inserted comprehension questions maintained and shaped information processing skills which were relevant to the post-test. Whereas, for the other

groups, answering inserted questions which entail verbatim recall maintained and shaped information processing skills which were irrelevant to the post-test.

The important implication from the above study is that, in order to utilize question-asking as a technique for enhancing comprehension, one should construct questions that assuredly require comprehension.

Bloom stated that:

> "...the main task of the education process is to change the learners in desirable ways, and that it is the primary task of teachers and curriculum makers to specify in precise terms the ways in which students will be altered by the learning process." (Bloom, 1971, p. 17)

If one accepts this position, then questions presented to students should stem from the educational objectives.

Bloom and his associates (1956) defined educational objectives in terms of levels of cognition. They distinguish between knowledge, comprehension, and other categories. Knowledge was defined as "little more than the remembering of the idea or phenomena in a form very close to that in which they were originally enoountered" (pp. 28-29) whereas comprehension referred to "understanding of the literal message contained in a communication" (p. 89). Comprehension was to be inferred from the capacity to deal with an "abstraction" in a form somewhat different from that in which it was originally presented.

The questions used in most of the mathemagenic research dealt only with the lowest level of learning -- knowledge. What is needed is research utilizing questions controlling learning on all levels of cognition.

b. Position of question in text

The position of questions relative to the related content appears to be a determinant of reading behaviors. Rothkopf (1965) inserted questions in ordinary text either before or after the material to which they related. He determined how much readers learn from the text to which the adjunct question relates (the relevant information), and how much they learn from the text which is not related to those questions (the incidental information). In general, he found that subjects learn most when the questions come after the material to which they relate. This finding was replicated several times (Rothkopf, 1966; Rothkopf and Bisbicos, 1967; Frase, 1967).

The replication studies revealed that questioned groups, in comparison to control groups which did not see adjunct questions, retained more of the question-related material. Post-question groups retained somewhat more incidental information, but the pre-question groups retained relatively little incidental information. In some cases (Frase, Patrick and Schummer; 1970), groups that saw questions before reading the passage tended to retain less incidental information than control groups which did not read the question.

Rothkopf has argued that questions asked during the course of a lesson maintain and shape the student's attention and processing -- what Rothkopf calls "mathemagenic behavior".

In all of the mathemagenic research cited above, "learning" from text material is measured by the amount of recall of factual information (relevant and incidental). Thus, most of the questions employed in these studies have tested verbatim recall. In studies employing another criterion, different results were obtained.

Morasky (1970, 1972) studied the effect of question placement (i.e., before or after the reading paragraph) on eye movements and on reading time. The results of these studies indicate that placing a question before the associated information reduces both paragraph reading time and the number of eye movement regressions.

These studies suggest that subjects viewing questions before paragraphs were behaviorally more biased (and, perhaps, more efficient) than the subjects viewing questions after paragraphs. It is possible that, when a question is placed before the passage, a matching process occurs which aids subjects in identifying relevant information. With questions following paragraphs, the subject must attempt massive storage of information for subsequent recall when the question is presented. The redundancy provided by eye movement regression should facilitate extensive information storage, whereas the specific search associated with a matching task should make redundancy less necessary.

Other studies (Holmes, 1931; Stein, 1952; Anderson, 1971), have demonstrated that subjects who saw a question before reading attained higher scores on a reading comprehension test (given immediately after reading and then two weeks later) than subjects who saw no questions but who read carefully and reread the same passage.

2 Definitions of Reading Comprehension

The term "definition" is not used here in its formal sense; it is used to indicate conceptualizations of the reading process as they are reflected in the literature.

The literature on reading comprehension (often the term "reading" is used synonymously) usually fall into two categories:

a. Studies in which reading comprehension is conceptualized as a "product".

b. Studies in which reading comprehension is conceptualized as a "process".

a. Reading comprehension as a "product". Studies in this category attempt to identify the separate skills comprising reading comprehension. Their definitions of reading comprehension fall at various positions along a "specificity - generality" continuum (Rankin, 1962). Some investigators (Bond et al, 1960; Strang et al, 1955) imply that "reading" consists of a large number of separate, specific skills, while others (Davis, 1944; Langsam, 1941) imply that it consists of a relatively small number of factors.

Perhaps the extreme in "specific" definitions is provided by Burkhart (1945) who found that "...reading is not a single act, but is a complex activity made up of at least 214 separate abilities..." (p. 439).

When factorial analysis techniques are applied to reading test results in order to determine the fundamental components of reading comprehension, only a small number of skills is identified. Langsam (1941) has identified two comprehension factors -- "vocabulary" and "seeing relationships". Davis (1944) found six fundamental factors as being statistically significant, but two factors -- "word knowledge" and "reasoning in reading" accounted for eighty-nine percent of the variance. Hunt (1957) reanalyzed Davis' data and reported finding only two factors.

Holmes (1965) applied statistical treatments to data obtained from the results of over fifty tests administered to high school students. Word meaning accounted for 32 percent of the differences in reading power. Verbal analogies and listening comprehension accounted for another 32 percent. Twenty-five percent of the re-

maining differences were unaccounted for.

Most of the factorial studies agree on the importance of the "vocabulary" or "word meaning", and the "reasoning factor" or "seeing relationships". The finding of these studies are, to some degree, a function of the number and particular type of tests used and the terminology used by different investigators to describe their findings.

b. Reading comprehension as a "process". Studies in this category are concerned with the analysis of the ongoing process of comprehension.

Holmes (1965) proposed the theory that different centers of the brain store information received in visual, auditory, and kinesthetic forms. These coded images are collected during reading through three levels of subabilities which interact with each other in hierarchical fashion. The product of this interaction is Reading Power (comprehension).

According to another theory (Neisser, 1967; Rothkopf, 1970; Anderson, 1972) elements of text are first encoded in terms of perceptual features (orthographic encoding). The next level of processing involves acoustic features (phonological encoding). At this stage, strings of words are translated into implicit (or explicit) speech. Finally, there is a semantic encoding, that is, the person may bring to mind meaningful representation based on words he sees. A person must be able to co-ordinate the "surface information" embodied in the orthographic and phonological codes in terms of linguistic rules (Chomsky, 1965) in order to arrive at a proper semantic encoding.

Research on memory provides some evidence supporting the encoding theory. Most errors in short-term memory arise from confusion between sounds even if the stimuli are presented visually (Wickelgren, 1965;

Hintzman, 1967). In long term memory, errors attributable to confusion in meaning are much more common than errors due to acoustical confusion (Baddeley, 1966). These data suggest that a printed verbal stimulus is usually phonologically encoded and then, if it is to be remembered for more than a few moments, it is semantically encoded. A study by Bobrow (1970) indicated that when skilled readers learn from written text, ordinarily they store meanings rather than strings of symbols or speech sounds.

We do not yet have a complete model of what a person has in his mind when he comprehends a communication. One theory is that meanings are represented as mental images (Paivio, 1969). It seems impossible to explain comprehension of abstract terms such as "truth" through the use of the imagery theory. Similarly, it is difficult to explain the comprehension of terms depicting an entire class of things. For instance, there is no general image of the entire class of things called "flowers". An image can be formed of a "rose" or a "tulip", but an image of a particular flower cannot represent the properties of the whole class.

Another theory holds that when a person comprehends a word, he brings to mind (not necessarily consciously) a complex of distinctive features (Collins and Quillian, 1969). For example, under "hammer" a person stores only the attributes distinctive of hammers. Characteristics of all tools are stored under "tool".

Most of the above theories are incomplete yet. What is needed is a model that will describe in greater detail the component parts of the comprehension process and how they function in the ongoing process. This model will guide the construction of teaching materials. Semmelroth's conceptualization of the reading process provides such a model.

Theoretical Framework

The theoretical framework for this study is based on Semmelroth's definition of reading. He defines reading as:

> "...information processing in which information is conceived as internally existing uncertainty in the form of alternatives to be matched with sensory events." (1968, p. 29)

Reading is conceptualized as a very active behavior in which the reader, relying on past experience, spontaneously attempts to predict what the written text should be, and uses the visual information to confirm his predictions. Each segment read in a text activates in the reader's mind possible alternative responses, as one reads the sentence,

David was swimming in the _____.

Arousal of the following alternatives might occur: river, lake, ocean, sea, pool. Each of these alternatives is a spontaneous attempt to predict a response for the parts not read yet.

According to Semmelroth, uncertainty (i.e., information[1]) refers to the predictability of an event; the greater the predictability of an event, the less uncertainty it contains.

The statement is illustrated in the following two examples.

| High Uncertainty (low predictability) | Low Uncertainty (high predictability) |
|---|---|
| 1. The boy was sitting at the _____. | 2. In the classroom, the boy was sitting at his _____. |

[1] The term "information" as used in information theory, refers to the predictability of an event. A random series of events contains more information than a non-random series. Thus, information=unpredictability=uncertainty. An organism is in a state of uncertainty when it "is faced with a stimulus situation to which it has no appropriate response... the primary motive force of organisms is the reduction of uncertainty." (Smith, D.E.P., 1969; pp. 8-9)

In the first example, there are many possible alternatives that have equal probability of occurrence, e.g. table, desk, station, door, etc. Whereas in the second example, the word "desk" is highly predictable.

Semmelroth points out two important characteristics of uncertainty: "1) it reaches a maximum when all of the alternatives in a situation have equal probability of occurrence" (1968, p. 27). This would be the case for guessing, "head" or "tail" in a toss of a coin. 2) "It increases as the number of possible alternatives increases" (1968, p. 27). For instance, guessing a number of a throw of a die contains more uncertainty than guessing "head" or "tail" in a toss of a coin.

According to Semmelroth, an input produces uncertainty within the reader in the form of alternatives. The alternatives differ with different readers depending upon the prior knowledge and skill of the reader. For example, the word "thinking" in a book title may raise in the novice reader alternatives in the form of words and letter shapes; the same input may stimulate in a philosophy professor alternatives in the form of guesses about differences in theories.

The alternative internal states are conceptualized by Semmelroth as "simultaneously firing neural networks" (1968, p. 29). Information may be processed in two ways.

1) "processing of information could refer to the choice of one of these networks through the interaction of sensory stimulation (looking at the word on the page) and the operation of the active networks. This process can be seen as a matching between the sensory input and the appropriate network". (i.e., recognition)

However, this condition may not take place because an appropriate network has not been active.

2) "the initiation of firing in approrpriate networks so that matching can take place". (1968, p. 29)

For example, when reading the following sentence

David was swimming in the _____.

the reader tries to predict a response, thus stimulating uncertainty in form of alternatives such as: sea, river, lake, pool. One of these alternatives matches the word on the printed page. He reads, "David was swimming in the lake." His guess was confirmed (matched) by the printed page, thereby reducing his uncertainty.

In case of no match between one of the alternatives generated and the printed word, the reader may have to select some more graphic cues and generate new alternatives.

This model of the reading process implies that the alternatives must exist in the reader's repertoire, since the arousal of alternatives is the reactivation of previously learned responses. The alternatives must also be classified or categorized so that the number of possible alternatives can be handled efficiently. As Brethower says:

> "We can conceptualize reading as if the reader has "stored" (and cross-indexed) many classes of outputs and many exemplars of each class. The inputs serve to guide, first, selection of the class and then the selection of the exemplar of the class. The exemplar is then compared to the input and to general constraints on outputs to see if it is an acceptable output." (1970, p. 12)

In other words, the written material is used to first guide the generation of alternatives and then to discriminate whether the alternative selected conforms to general linguistic constraints and corresponds to the characteristic of the input.

> "It is as if the reader 1) asks for each input 'What do I know that relates to this?' 2) recalls (or generates, or actively considers) those related items, selecting among them one which 3) matches linguistic constraints and characteristic of the input." (Brethower, 1970, p. 13)

When processing information, the reader makes use of semantic and syntactic cues. Syntax deals with the "rules by which sentences are ordered" (Smith, F. 1971, p. 28), whereas semantics is concerned with the meaning of individual words and how these meanings are put together. The use of semantic and syntactic cues is illustrated in the following example:

"The brave _____ rode the white horse."

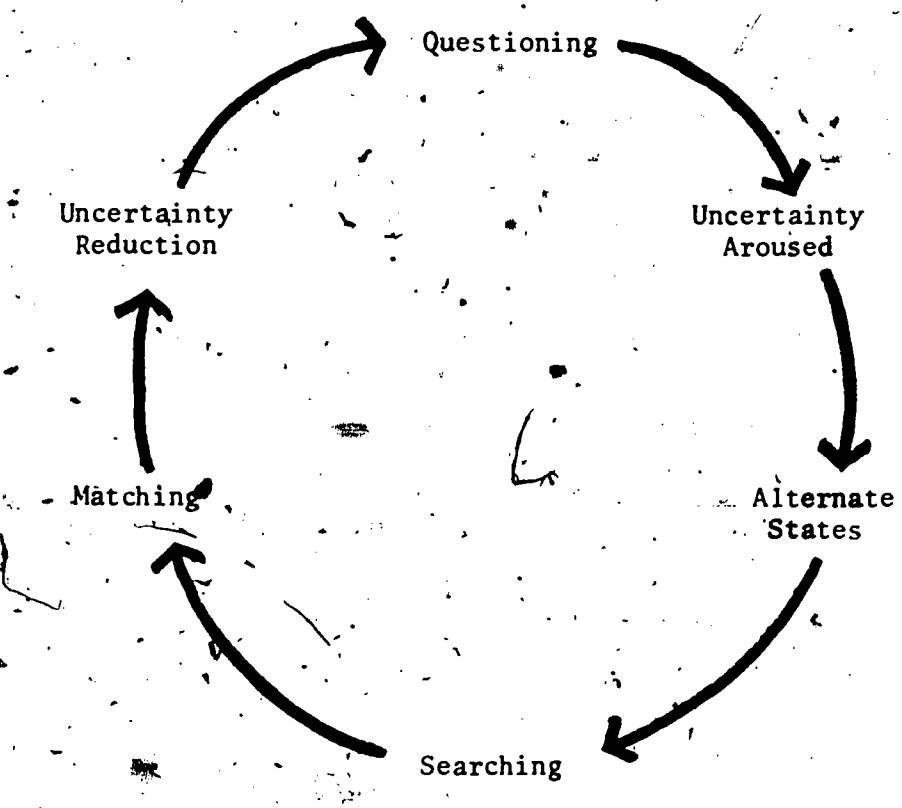
The space can be filled only by a noun; other alternatives (e.g. verbs, prepositions) are eliminated because of grammatical relations among the elements in the sentence (i.e. syntax). Some nouns such as "flower", "rock", "house", "table", must be excluded because of the sense of other words in the sentence (i.e. semantics).

The cues the reader picks up when processing his uncertainty are not gathered only from left to right. While the adjective "brave" eliminates some alternatives that could be substituted in the space that follows it, other alternatives are eliminated by the words that are given at the end of the sentence. As Frank Smith says:

> "Information is available at every point to reduce the number of alternatives remaining for those parts of the sequence that have not been encountered." (Smith 1971, p. 193)

This model holds that processing of information is continuous in a cyclic pattern.

The cyclic process is illustrated by the following diagram.




In summary, according to Semmelroth, two conditions are necessary for reading to occur:

1) the existence of uncertainty within the reader in the form of active alternative responses; and
2) the reduction of uncertainty or information processing.

Domain of Questions

Generating questions and predicting answers before reading stimulates uncertainty; the reader can encapsulate uncertainty within question requirements and reduce it by answering the question. Furthermore, processing of uncertainty requires that the active alternatives are relevant to the material read. Therefore, the questions generated by the reader must continuously be revised to fit the passage.

In order to effectively use questions as a means of controlling reading, one should be able to:

1. Transform statements into different kinds of questions.
2. Initiate reading with a set of questions, and then reformulate the questions as he reads.

Anderson (1972) and Bormuth (1970) classify questions into five classes, according to the manner in which they are formed.

a. Verbatim questions - in order to form this type of question, "A statement is taken in literal word-by-word form from the text" (Anderson 1972, p. 149) and transformed into a question.

b. Transformed verbatim questions - the form of a sentence is somewhat changed by rearranging the order of its elements and applying logical and syntactical transformations.

These two types of questions are illustrated in the following examples:

| Stimulus Sentence | Question | Type |
|---|---|---|
| Dan rode a bike. | 1. Did Dan ride a bike? | Verbatim |
| | 2. Who rode a bike. | Verbatim |
| | 3. By whom was the bike ridden? | Transformed Verbatim |

c. Paraphrase questions - "Two statements are defined as paraphrases of one another if 1) they have two substantive words (nouns, verbs, modifiers) in common, and 2) they are equivalent in meaning." (Anderson, 1972, p. 150) When generating a paraphrase question, one uses synonyms of the original statement.

d. Transformed paraphrase questions - "Questions in this class are made from paraphrases which have been rearranged or transformed." (Anderson, 1972, p. 151)

The above two types of questions are illustrated in the following examples. (Bormuth 1970, p. 48)

| Stimulus Sentence | Question | Type |
|---|---|---|
| The diminutive youth mounted the steed. | 1. Who climbed on the horse? | Paraphrase |
| | 2. By whom was the horse climbed on? | Transformed Paraphrase |

e. Intersentence questions - these questions ask about information signaled by the relationships between sentences. "The relative position of sentences, paragraphs and so on, signal causation, sequence in time, subordination, and several other kinds of information." (Bormuth 1970, p. 53)

The questions falling in this class can sometimes be referred to as inference questions. They are illustrated in the example below. (Bormuth 1970, p. 52)

| Stimulus Sentence | Question | Type |
|---|---|---|
| Joe sat under the tree. The air was cool. | Where was the air cool? | Intersentence |

Although these five classes of questions are arranged according to complexity of question generated, the basic form of question used in all classes falls into the who, when, where, what, how and why category. The difference in complexity of question is in terms of the number and kind of cues used, the amount of text needed to be processed in order to answer the question, and the length of the required answer.

D.E.P. Smith (1969) classified questions into two main groups:

1. Definitional questions - questions falling into this class ask about one or more parts of the main idea (i.e., definition) of the written material. (e.g. chapter, paragraph, sentence) These questions usually ask about the following parts of the definition: the topic of the material, the class of the topic, the description of the topic, and the relevance of the topic. The following questions may be generated for each of these parts:

| | | |
|---|---|---|
| Topic | -- | What is the material about? |
| Class | -- | What is a general name for the topic?<br>To what class does it belong? |
| Description | -- | What are the topic's characteristics?<br>How does it look?<br>What are its parts and how do they work together? |
| Relevance | -- | What is it used for?<br>Why is it important?<br>What is its purpose? |

2. Relational questions - these questions ask for the similarities and/or differences between two definitions or parts of two definitions. They are generated in the form of a comparison or contrast.

| | | |
|---|---|---|
| Comparison | -- | How are they similar? |
| Contrast | -- | How are they different? |

The definitional questions, as defined by Smith, cut across all five categories of questions in the first classification (Anderson and Bormuth). Whereas the relational questions will probably fall in the "intersentence

question" category as defined by Anderson and Bormuth.

When training children in the art of questioning, one should start with the verbatim questions (definitional) and then proceed to the more complex types of questions.

## CHAPTER II

## LABORATORY PHASE: PROGRAM DEVELOPMENT

According to the analysis in Chapter I, the presence of uncertainty within the reader is a critical condition in the comprehension process. The reader can use questions as a means of "encapsulating his uncertainty." In order to do this, he needs practice in question generation. Therefore, I have designed programmed instructional materials to give elementary school students training in generating questions.

### Objective of Question Generating Program

The objective of the question generating program reported in this study is as follows:

Given paragraphs containing basic vocabulary at an elementary level, students will generate two interrogative questions of the who, when, where, what, how, why category for each paragraph.

### The Programming Strategy

In the development of the question generating program, the programmer used the "lean programming" approach. The major point of this strategy is to include minimum teaching material in the early drafts and to start adding instructional materials as the result of the analysis of student responses and reactions in tryouts. The program is thus approximated successfully, starting with an incomplete draft and filling it out where the tryout data suggest. David G. Markle made the following comments about the "lean programming" strategy:

> "...the programmer who has the necessary courage, can admit that he really has very little knowledge of what his students need - hunches, to be sure, but little knowledge. It is a short step to using the criterion item sequence alone as a first draft, with no instruction at all...this approach would not be useful in an area in which the students had absolutely no relevant behavioral repertoire. But typically, the student does have a relevant repertoire. The difficulty is that the programmer does not know what it is." (Markel, 1967; p. 2)

What follows is that, when developing programmed instructional materials, one starts with a lean framework of a program, sometimes consisting of only the criterion frames, and adds instructional material through a continuous process of trial and revision until a desirable level of performance on the criterion items is achieved.

The early tryouts are carried out with individual students. The purpose of the individual tryouts is to get information about the instructional needs of the students. The program is not expected to "work" yet. The programmer observes the student as he works. He records the time for each item and any comments made by the subject. The programmer also watches for signs of puzzlement, boredom, or fatigue. If difficulty occurs, the programmer explores the difficulty with the student using open-ended questions.

When the investigator thinks that he has attained a workable instructional program, he tries it out on a group of students representing the target population. The goal of the group tryout is to determine problems which may arise in a field setting. Group tryouts also provide additional information about items needing further revision.

The early stages of the laboratory phase of the question generating program were carried out with individual subjects ranging in age from seven years five months, to ten years ten months. Each subject was

observed carefully as he worked and the program was revised on the basis of the student responses.

A description of the four main drafts and revisions of the program follows.

1. First Draft of Program

The development of the program started with construction of a criterion test. The test contained one paragraph and students were asked to write three test questions for the paragraph. Analysis of student responses on the test showed that questions written by students fell into several distinct classes as shown in the following example.

| Stimulus Sentence | Student's Response |
|---|---|
| Dan is riding a bike. | 1. Dan is riding a bike.<br>2. Dan is riding a bike?<br>3. Dan is riding a bike, is he?<br>4. Is Dan riding a bike?<br>5. Who is riding a bike? |

In response (1), the student copied the stimulus sentence. In (2), a question was generated by changing the intonation and adding a question mark. In (3), the sentence is transformed into a "yes" or "no" type question by copying the stimulus sentence and inserting an auxiliary or the word "have", or a form of the word "do", and a question mark at the end of the sentence. In (4), a "yes" or "no" type question is generated by inserting an auxiliary word at the beginning of the sentence. Response (5) is the desirable terminal behavior; one of the Wh words is used in forming the question. In addition to these five classes of responses, students often wrote questions which were not related to the paragraph's general topic or could not be answered by the paragraph. Another common error was the omission of a question mark.

This analysis confirmed early assertions of the programmer that in order to generate the who, when, where, what, how, why type questions, one should make the following basic discriminations:

1 Discriminate between a question and a non-question.

a. A question asks for an answer.

b. A question ends with a question mark.

2 Discriminate between a good question and a poor question.

a. A good question starts with a question word.

b. A good question asks about the material read.

c. A good question can be answered by the material read.

The next step was to arrange the above required responses in a logical sequence and to write the teaching frames for each step. The items used as foils (i.e., wrong answers) in the program were based on students' initial responses on the test.

The first draft of the program included two separate booklets. The first one (A) contained ten paragraphs. The second booklet (B) was a response book. It included six separate sections. Each section contained an example, a general rule, and a set of ten frames, each pertaining to a different paragraph in booklet (A).

The first two sections called for a recognition response.

Section I dealt with the discrimination between a question and a non-question. It presented 10 pairs of sentences, each pair consisting of one target and one foil.

Section 2 was similar, but the discrimination taught was that between good and poor questions.

Section I

A question always asks for an answer and ends with a question mark.

Example 1

Read the paragraph below:

The Mackinac Bridge is one of the most beautiful bridges in our country. It is located in the state of Michigan and spans a body of water called the Straits of Mackinac. The bridge is about five miles long and connects the upper and lower peninsulas of Michigan. Each year many people come to Michigan just to cross the Mackinac Bridge.

Circle the question below:

1. Where is the Mackinac Bridge located?
2. The Mackinac Bridge is very long.

Answer: (1) is a question because it asks for an answer and ends with a question mark.

Read paragraph A then circle the question below.

1. Why are camels good desert animals?
2. A camel can travel a long distance.

Section 2

A good question for a paragraph is about the paragraph.

Example 2

Read the paragraph below:

When you get a new puppy, you should get it in the morning. Then, the dog will have a long day in which to get to know you. It is best if you can bring the dog home on a Saturday morning. This will give you a whole weekend to get to know the new dog.

Circle the better question.

1. How much chocolate did you eat today?
2. When should you get your new puppy?

Answer: (2) is the better question because it is about the paragraph.

Read paragraph A then circle the better question.

1. Where does an eagle live?
2. Where does a camel store its food?

Section 3 dealt with the discrimination between a good question and a poor one. It included ten pairs of questions, one target and one foil.

Section 3

A good question can be answered by reading the paragraph.

Example 4

Read this paragraph.

People have always wanted to know what the coming weather would be. Many years ago, men found that they could sometimes predict weather changes by watching for signs in nature. Today we learn about coming weather from weather reports. These reports are based on weather news collected by more than 2,000 weather stations all over the world.

Circle the better question:

1. Why did people watch for signs in nature?
2. How does a weather station collect weather information?

Answer: (1) is the better question because it is answered by the paragraph.

Read paragraph A then circle the better question.

1. What foods do camels like to eat?
2. What does a camel store in its hump?

Section 4 involved sentences with modified cloze exercises which taught discrimination between appropriate and inappropriate question words.

Section 4

Read paragraph C , then circle the appropriate question word.

Why/when is space like a clear, dark night?

Section 5 dealt with discrimination between good and poor questions. It presented 10 pairs of sentences, one target and one foil. The last section called for production of a "good" question for each of the paragraphs in booklet A.

Section 5

Read paragraph A , then circle the better question.

1. Is the camel a strong animal?
2. Why are camels called "ships of desert?"

Section 6

Read paragraph A , then write a good question for it.

_____

_____

On the basis of student responses on the first draft of the program, the programmer realized that reading paragraphs prior to making the discrimination between a question and a non-question is superfluous. A similar problem occurred in teaching the discrimination between good and

poor questions. It was realized that when generating questions, students transform single sentences into questions. Therefore, the second draft presented those discriminations in relation to single sentences.

Frequent requests of students in Section 6 of the draft to remind them of the possible question words resulted in an addition of a section which provided additional practice in using question words. The other major revision concerned the criterion test. The paragraph used in the first draft did not contain enough details for the generation of three questions, therefore, it was replaced in the second draft.

2. Second Draft of Program

The second draft also consisted of two booklets, one containing ten paragraphs, the other containing the programmed instructional materials. The second booklet included eight separate sections.

Sections 2, 4, 7 and 8 were identical to Sections 3, 5, 6 and 7 in the first draft.

The first section dealt with the discrimination between a question and a non-question. It presented a rule, an example, and ten pairs of sentences, one target and one foil.

Section 1

A question asks for an answer and ends with a question mark.

Circle the question:

1. Where is the Mackinac Bridge located?
2. The Mackinac Bridge is very long.

Answer: (1) is a question because it asks for an answer and ends with a question mark.

Circle the question:

1. Why are camels good desert animals?
2. A camel can travel a long distance.

Section 3 presented a set of nine sentences, some questions and some non-questions in which the question marks and periods were deleted.

Section 3

Fill in the blank with a period or a question mark.

Who gave the sandwich its name___

Section 5 included sentences with modified cloze exercises which gave the student training in discriminating between appropriate and inappropriate question words.

Section 5

Read this sentence:

| David climbed up the hill. |
|---|

Which question is answered by the above sentence?

Circle the correct question word.

When/who climbed up the hill?

Answer: who climbed up the hill?

This is the question answered by the sentence above.

Read this sentence:

| A camel can store food in its hump. |
|---|

Which question is answered by the above sentence?

Circle the correct question word.

Who/where can a camel store food?

Section 6 was similar, but the question word was deleted.

Section 6

Read this sentence:

| A camel is a perfect desert animal. |
|---|

Fill in the missing question word in the blank.

_____ is a perfect desert animal?

As a result of student responses, several more major revisions were made. The draft presented two discriminations between a question and a non-question in the same section, which proved to be too difficult for the learners. Therefore, the third draft presented only a single discrimination in each section. Few prompts reviewing the rules were added to each section. Finally, the layout of the program was changed so that the booklet was now 4-1/4" x 5-1/2", rather than 8-1/2" x 11", as it had been for the first and second drafts.

3. Third Draft of Program

The third draft consisted of two separate booklets, the same as the first and second drafts. The response booklet included nine sections. Sections, 4, 5, 6, 7, 8 and 9 were identical to Sections 2, 3, 4, 6, 6 and 8 in the second draft.

Sections 1, 2, 3 dealt with various discriminations between a question and a non-question. Each section presented a rule, an example, and eight pairs of questions, one target and one foil.

Section 1

A question always ends with a question mark.

Circle the question:

1) Who wrote this book?

2) I like this book very much.

Yes, (1) is a question because it ends with a question mark.

Circle the question:

1) How old are you?

2) I have two brothers.

Section 2, Page 2

A question always asks for an answer.

Circle the question:

1) Drivers use maps to find their way.

2) How are maps useful?

Section 3

A question usually starts with one of these question words:

| | | |
|---|---|---|
| Who | Where | How |
| When | What | Why |

Circle the question:

1. Boats float on water.

2. Who was Lincoln?

The third draft was tested in a combined third and fourth class in the Lakewood Elementary School on the West side of Ann Arbor, Michigan. 20 students participated in the study. The errors students made on the program were tabulated in the following table. Each cell depicts the number of students who made an error on the corresponding item.

TABLE 1

Summary of Errors Made on Third Draft of Question Generating Program by 20 Third and Fourth Grade Students

| # Item | Sec 1 | Sec 2 | Sec 3 | Sec 4 | Sec 5 | Sec 6 | Sec 7 | Sec 8 | Sec 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | | | | 1 | | | 2 | |
| 2 | | | | 3 | 5 | 2 | | 6 | |
| 3 | 1 | | | 6 | 5 | 2 | 1 | 5 | |
| 4 | 1 | | | 1 | 4 | 3 | | 6 | |
| 5 | | | 4 | 3 | | 8 | 2 | 10 | |
| 6 | 1 | 2 | 1 | 3 | | 7 | 3 | 10 | |
| 7 | | | 1 | 3 | 5 | | 1 | 6 | |
| 8 | 1 | 5 | 1 | 7 | 1 | 10 | 4 | 5 | |
| 9 | | | | 3 | 3 | 4 | | 6 | |
| 10 | | | | 5 | | | 4 | 3 | |

As a result of the analysis of the errors made on the draft, the questions asked by students, and the teacher's comments, several more major revisions were made.

Many questions about words were asked by students; therefore; the vocabulary was completely changed in the new draft. The repetitive use of the same set of paragraphs throughout the draft proved to result in memorization of previous questions, thus interfering with learning. Therefore, in the fourth draft, new paragraphs were introduced in each section. The paragraphs were worked into the body of the program rather than being compiled in a separate booklet as in the first three drafts.

It seemed as if the errors in Section 4 of the draft stemmed partly from difficulty in vocabulary and partly from lack of practice in production tasks. Therefore, production tasks were added to Sections 2 and 3 of the new draft.

Analysis of the errors on Sections 5, 6 and 8 proved that the presentation of the discrimination between good and poor questions for paragraphs was too difficult for the learners. Therefore, two sections dealing with good questions for sentences were added to the fourth draft; analysis of student responses on Section 9 and the criterion test provided additional evidence for the need of a more gradual presentation of the discrimination between good and poor questions. (A special point system was devised for the scoring of responses written in Section 9 and, therefore, the errors are not summarized in Table 1.)

An answer sheet was inserted at the end of each section in order to provide immediate feedback to students. A self evaluation check list was provided at the end of Sections 8 and 12. Another revision concerned the presentation of the general rules. In the fourth draft, the rule was presented on a separate page, facing the first

page of the section. This was in lieu of the prompts included in the third draft.

4. Fourth Draft of Program

The fourth draft of the program included six separate booklets, each containing two lessons.

The first three lessons dealt with discriminations between questions and non-questions. Each lesson presented a rule, an example, and several pairs of sentences, one target and one foil.

Lesson 1, Page 1

Read A, then circle the question.

---

A.

1. Who wrote this book?

2. This is a funny story.

Yes, (1) is a question because it ends with a question mark.

---

Do B - P the same way.

---

Lesson 2, Page 5

Put a ? after the question.

A.

1. What is your name
2. I like to go fishing

Yes, (1) is a question because it asks for an answer.

Do B - P the same way.

Lesson 3, Page 8

Put a ? after the question.

A.

1. Boats float on water
2. How old is John

Yes, (2) is a question because it starts with a question word.

Do B - P the same way.

The fourth lesson presented a set of sixteen sentences in which the question marks and the periods were deleted.

Lesson 4, Page 13

Put in the _____ a period or a question mark.

_____

1. What makes a car go _____

_____

The fifth lesson taught the discrimination between good and poor questions for sentences.

Lesson 5, Page 16

Circle the better question for the sentence below.

A.

Dan is riding his bike.

1. What is Dan riding?
2. What color is the bike?

Yes, (1) is the better question because it is answered by the sentence.

Do B - N the same way.

The sixth lesson presented a "fill in the blank" type exercise, providing practice in the proper use of various question words.

Lesson 6, Page 23

Write the missing question word

in the _____.

_____

Jane read a good book.

1.

_____ read a good book?

Yes, who read a good book? is the question that is answered by the sentence.

_____

Do 2 - 13 the same way.

_____

Lesson 7 provided a review of the discriminations taught in the previous sections.

Lesson 7, Page 28

Circle the better question for each sentence.

(A - M)

A.

Cowboy Rick rides a white horse.

1. Is Rick a cowboy?
2. What does Rick ride?

Lesson 8 presented a set of nine sentences and called for production of a good question for each of the sentences.

Lesson 8, Page 33

Write a good question for each sentence.

1.

A camel is a good desert animal.

Lessons 9 and 10 dealt with the discrimination between good and poor questions for paragraphs. Each lesson included several paragraphs and a pair of questions for each paragraph, one target and one foil.

Lesson 9, Page 36

Circle the better question for the story below.

A.

The camel lives in the desert.
He has a big hump on his back.

1. When does summer start?
2. Where does a camel live?

Yes, (2) is a better question because it is about the story.

Lesson 10, Page 41

Circle the better question for the story below.

A.

Lisa has a red bike. David has a blue bike. They like to ride their bikes in the park.

1. How old is Lisa?
2. What color is Lisa's bike?

Yes, (2) is the better question because it is answered by the story.

Do B - L the same way.

Lesson 11 provided a review of the discrimination taught in the previous two lessons. The last lesson presented a set of 10 short paragraphs and called for production of a good question for each paragraph.

Lesson 11, Page 47

Circle two good questions for the story below.

---

A.

There were different groups of Indians. Some were fishermen and some were farmers. The Indians who lived in the plains were hunters.

1. Where did the farmers live?
2. What Indians were hunters?
3. Where did the hunters live?

Lesson 12, Page 54

Write one more question for each story.

A.

David lives near a lake. Every day he goes fishing. Today he caught seven fish. He decided to have a fish fry on the beach.

1. How many fish did David catch?

2. _____

_____

Criterion Goal

The pre and post test was divided into two subtests.

Part I -- Criterion subtest included five paragraphs. The subjects were asked to generate two "good" questions for each paragraph. The criteria for a good question were: (1) it asks for an answer; (2) it ends with a question mark; (3) it starts with a question word; (4) it is about the paragraph; and (5) it can be answered by the paragraph.

Part II -- Standardized subtest consisted of one example and four paragraphs with two questions pertaining to each paragraph. The items in this part were taken from the Developmental Reading Tests-Bond-Clymer-Hoyt. Upper Primary Reading, Form UG-A, General Comprehension Section. There were a total of eight items in this part.

The criterion goal was that ninety percent of the subjects in the experimental groups would achieve eighty-five percent accuracy on Part I -- criterion subtest of the post test.

Internal Validation Procedure -- Pilot Study

1. Subjects

The pre-test was administered to twenty-nine fourth graders at the Thompson Elementary School located in St. Francis, Wisconsin. Thirteen of these students demonstrated mastery by scoring eighty-five percent correct or better (9 errors or less) on Part I -- Criterion subtest.

The remaining eleven boys and four girls were used as subjects in the pilot study. The children ranged from eight years, ten months to ten years, 1 month in age.

2. Procedure

The fourth grade classroom teacher administered the pre- and post-test and the program during the training period. The investigator observed the work session periodically. The subjects met in a small group at the back of their classroom to work on the program.

Only instructions contained in the question generating program were read to the children. After going through the example for Lesson 1 with the teacher, the student was able to finish the lesson on his own. The teacher then explained how to use the fold-out answer sheet after which, the student was able to do each succeeding lesson on his own. Teacher's aid was needed also at the end of Lesson 8 - self-evaluation check list. The teacher was instructed to respond to student's questions about words by suggesting that the student try to figure it out by himself. If he could not do so, the teacher was instructed to read the word and mark the difficulty in the student's book for the investigator's information. However, the only questions asked by the students were questions about spelling of certain words. The teacher was instructed to write the word on a piece of paper and hand it to the student.

Each student worked on the program at his own rate, completing two lessons daily. Although the length of each instructional period was twenty minutes per day, some children completed their work earlier and returned to their regular seat.

The fifteen students went through the program in six instructional periods (plus two additional periods for the administration of the pre- and post-tests), or about two hours of instruction time.

TABLE 2

Error Rates of Fourth Grade Children at Thompson Elementary School on Question Generating Program Pre- and Post-Tests (Pilot Study)

| SUBJECT | | SUBTESTS | | | |
|---|---|---|---|---|---|
| | | PART I CRITERION[1] | | PART II STANDARDIZED[2] | |
| | | PRE | POST | PRE | POST |
| BOYS | 1 | 16 | 6 | 0 | 0 |
| | 2 | 16 | 0 | 0 | 0 |
| | 3 | 16 | 0 | 2 | 0 |
| | 4 | 17 | 0 | 0 | 1 |
| | 5 | 19 | 1 | 1 | 0 |
| | 6 | 45 | 1 | 1 | 1 |
| | 7 | 22 | 7 | 1 | 0 |
| | 8 | 30 | 4 | 0 | 0 |
| | 9 | 41 | 5 | 3 | 2 |
| | 10 | 43 | 0 | 3 | 0 |
| | 11 | 32 | 0 | 0 | 0 |
| GIRLS | 1 | 28 | 0 | 2 | 0 |
| | 2 | 19 | 9 | 2 | 0 |
| | 3 | 16 | 3 | 0 | 0 |
| | 4 | 25 | 3 | 4 | 3 |
| MEAN | | 25.7 | 2.60 | 1.26 | 0.47 |
| t | | 6.768 | | 1.914 | |
| p | | .01 | | N.S. | |

[1] Total possible score = 60

[2] Total possible score = 8

3. Evaluation

Upon completion of the program, the post-test (same instrument as the pre-test) was administered to the fifteen students.

As shown on Table 2, fourteen students (95 percent) demonstrated mastery (9 or fewer errors) on the post-test of the criterion subtest. Only one student was below the satisfactory level.

The data provided by the pilot study was used to make some minor revisions in few items in the program.

## CHAPTER III

## DEMONSTRATION PHASE: EXTERNAL VALIDATION

A summary of contents included in Chapter III of this study is as follows:

The first section describes the procedures followed in administering the question generating program and the subjects used in the study. The second section of the chapter presents the results of the study. An analysis of these results is discussed in the third section.

### Procedure

1. Description of Communities

The study was conducted concurrently in two different communities in the Milwaukee area. The first community, the town of St. Francis, is located about 10 miles south of Milwaukee. This community is predominantly white, working class, from a German or Polish origin. There are three elementary schools in the St. Francis School System. Thompson School, located in the east side of town, was used in this study. The other community is located in the northwest side of Milwaukee. This community is racially mixed; most families earn low-moderate incomes. Three elementary schools are located in this part of town. The North 24th Street School was used in this study.

2. Selection Procedure

The pre-test was administered to forty-six children in the two third grades of the Thompson School and to twenty-eight children in a third grade in the North 24th Street School. The pre-test was administered by the individual class teachers. Twenty-six children in these classes demonstrated mastery by scoring eighty-five percent

correct or better (nine or less errors) on Part 1 -- Criterion Subtest. The remaining forty-eight children served as subjects for the study.

Subjects were assigned to experimental or control groups randomly within classes.

The twenty-four children in the experimental group used the question generating program developed by the investigator. The control group received no supplemental instructional materials.

Descriptive data for sex, age, mean score and standard deviation on the criterion and standardized subtests for the three third grade classes (A, B, and C) are reported on Table 3.

3. Administration of Program

Prior to the beginning of the study, the investigator met with the three third grade teachers and the principals of the two schools. Explanations of the procedures to be followed for the administration of the program were presented by the investigator. Question generating program was provided to the twenty-four children in the experimental group (1 child in experimental group B became ill, and was later discarded from the study).

The experimental groups in two of the classes worked on the program at the back of their classrooms. The subjects in the third class worked on the program at their desks during a specified time period. One period of about fifteen minutes for six consecutive days was devoted to the training sessions.

At the first session, the classroom teacher worked out an example with the subjects, and explained how to use the fold-out answer sheet.

TABLE 3

A Comparison of Sex, Age, and Error Rate on Question Generating Pre-Test for Experimental and Control Groups in Three Third Grade Classes (A,B,C)

| CLASS | GROUP | N | SEX | | AGE | SUBTESTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CRITERION | | | | STANDARDIZED | | | |
| | | | M | F | $\bar{X}$ (MOS) | $\bar{X}$ | S | t | p | $\bar{X}$ | S | t | p |
| A | Exp | 7 | 3 | 4 | 99.71 | 30.86 | 19.94 | -.444 | N.S. | 2.50 | 1.87 | 1.52 | N.S. |
| | Cont | 7 | 4 | 3 | 101.57 | 34.86 | 13.08 | | | 1.14 | 1.34 | | |
| B | Exp | 6 | 3 | 3 | 100.50 | 34.17 | 15.61 | .211 | N.S. | 1.33 | 1.51 | .277 | N.S. |
| | Cont. | 7 | 5 | 2 | 100.57 | 32.57 | 11.76 | | | 1.14 | .90 | | |
| C | Exp | 10 | 4 | 6 | 99.20 | 43.80 | 12.04 | .122 | N.S. | 2.30 | 1.70 | -.419 | N.S. |
| | Cont | 10 | 4 | 6 | 98.70 | 43.10 | 13.54 | | | 2.70 | 2.50 | | |
| TOTAL | Exp | 23 | 10 | 13 | 99.74 | 37.35 | 15.10 | -.065 | N.S. | 2.09 | 1.69 | .557 | N.S. |
| | Cont | 24 | 13 | 11 | 100.08 | 37.62 | 13.25 | | | 2.04 | 1.93 | | |

[1] Ages of subjects are as of Nov. 15, 1972, when the pre-test was administered.

[2] Total possible score = 60

[3] Total possible score = 8

The students were then able to work on the rest of the program on their own.

Feedback on performance was provided by a fold-out answer sheet at the end of each lesson. The students were able to check their responses on the preceeding pages of each lesson. No record of errors was kept by the students or the teachers.

The investigator emphasized to the teachers during the initial meeting that the question generating program was self-instructional. When a student asked for a spelling of a word, the teacher was instructed to write the word on a piece of paper and hand it to the student. When a student asked a different kind of question, the teacher was instructed to first respond, "Try to figure it out for yourself." If the student repeated the question, the teacher was instructed to pronounce the word in question and underline it for the investigator's information.

The subjects in the control group received no supplemental instruction. When the experimental group was working on the program, the control group continued to do their regular assigned work along with the other children in the class.

## Results

The results of the study are presented in Table 4. On the criterion subtest, the mean number of errors on the pre-test for the experimental group was 37.35 and the post-test was 6.17, a difference significant beyond the one percent level. The mean number of errors on the pre-test for the control group was 37.62 and the post-test was 37.42 showing no significant change.

TABLE 4

A Comparison of Error Rates of Trained and Untrained Groups of Third Grade Children on Two Subtests of Question Generating Pre- and Post-Tests

| SUBTEST | GROUP | PRE-TEST $\bar{X}$ ERRORS | PRE-TEST S | POST-TEST $\bar{X}$ ERRORS | POST-TEST S | DIFF. | t | p |
|---|---|---|---|---|---|---|---|---|
| Criterion | Exp | 37.35 | 15.10 | 6.17 | 6.28 | 31.18 | 10.31 | .01 |
| | Cont | 37.62 | 13.25 | 37.42 | 13.57 | 0.20 | 0.23 | N.S. |
| Standard-ized | Exp | 2.09 | 1.69 | 1.00 | 1.37 | .88 | 2.39 | .05 |
| | Cont | 2.04 | 1.93 | 2.04 | 1.82 | .00 | -- | N.S. |

On the standardized subtest, the mean number of errors on the pre-test for the experimental group was 2.09 and the post-test was 1.00, a difference significant at the five percent level. The control group scored 2.04 on both pre- and post- subtests, no significant change.

Table 5 shows the percentage of correct responses produced by subjects on the criterion subtest. The experimental group scored 36.25 percent correct on the pre-test and 86 percent correct on the post-test. 87 percent of the subjects in the experimental group (20 out of 23) demonstrated mastery by scoring 85 percent correct or better on the post-test of the criterion subtest, whereas the control group scored 36 percent correct on the pre-test and 37.5 percent on the post-test. No subject in the control group demonstrated mastery on the post-test.

On the standardized subtest, the experimental group scored 74.5 percent correct on the pre-test and 88 percent correct on the post-test. The control group had 74.5 percent correct on the pre-test and 74.5 percent correct on the post-test.

A graph showing the percentage of correct responses is shown in Figure 1.

TABLE 5

Percentage of Correct Responses on Two Subtests of Question Generating Pre- and Post-Test of Trained and Untrained Third Grade Students

| | | EXPERIMENTAL | | | | CONTROL | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | SUBTESTS | | | | SUBTESTS | | | |
| | | CRITERION | | STANDARDIZED | | CRITERION | | STANDARDIZED | |
| GROUP | STUDENT | PRE | POST | PRE | POST | PRE | POST | PRE | POST |
| A | 1 | 28 | 92 | 62 | 75 | 40 | 38 | 88 | 75 |
| | 2 | 0 | 57 | 45 | 62 | 60 | 52 | 62 | 75 |
| | 3 | 58 | 100 | 88 | 100 | 28 | 45 | 100 | 75 |
| | 4 | 73 | 90 | 100 | 100 | 38 | 25 | 62 | 50 |
| | 5 | 60 | 87 | 75 | 75 | 8 | 0 | 88 | 88 |
| | 6 | 48 | 87 | 88 | 88 | 60 | 53 | 100 | 100 |
| | 7 | 37 | 85 | 50 | 75 | 68 | 57 | 100 | 88 |
| B | 1 | 72 | 93 | 50 | 100 | 38 | 48 | 75 | 88 |
| | 2 | 40 | 70 | 88 | 100 | 7 | 10 | 75 | 75 |
| | 3 | 43 | 100 | 100 | 100 | 70 | 67 | 100 | 100 |
| | 4 | 35 | 100 | 75 | 88 | 52 | 55 | 100 | 100 |
| | 5 | 0 | 93 | 88 | 100 | 48 | 47 | 88 | 75 |
| | 6 | 68 | 100 | 100 | 88 | 52 | 43 | 75 | 75 |
| | 7 | | | | | 53 | 53 | 88 | 88 |
| C | 1 | 0 | 90 | 75 | 62 | 0 | 0 | 50 | 62 |
| | 2 | 55 | 90 | 88 | 100 | 60 | 62 | 100 | 100 |
| | 3 | 32 | 100 | 50 | 88 | 23 | 0 | 25 | 25 |
| | 4 | 33 | 90 | 62 | 88 | 42 | 57 | 75 | 75 |
| | 5 | 0 | 85 | 25 | 62 | 0 | 0 | 50 | 50 |
| | 6 | 2 | 100 | 75 | 88 | 8 | 25 | 75 | 45 |
| | 7 | 32 | 85 | 75 | 100 | 15 | 17 | 12 | 25 |
| | 8 | 28 | 77 | 75 | 75 | 32 | 33 | 100 | 100 |
| | 9 | 38 | 93 | 100 | 100 | 42 | 42 | 75 | 62 |
| | 10 | 50 | 100 | 88 | 100 | 60 | 67 | 100 | 100 |
| Mean % Total | | 36.25 | 86 | 74.5 | 88 | 36 | 37.5 | 74.5 | 74.5 |

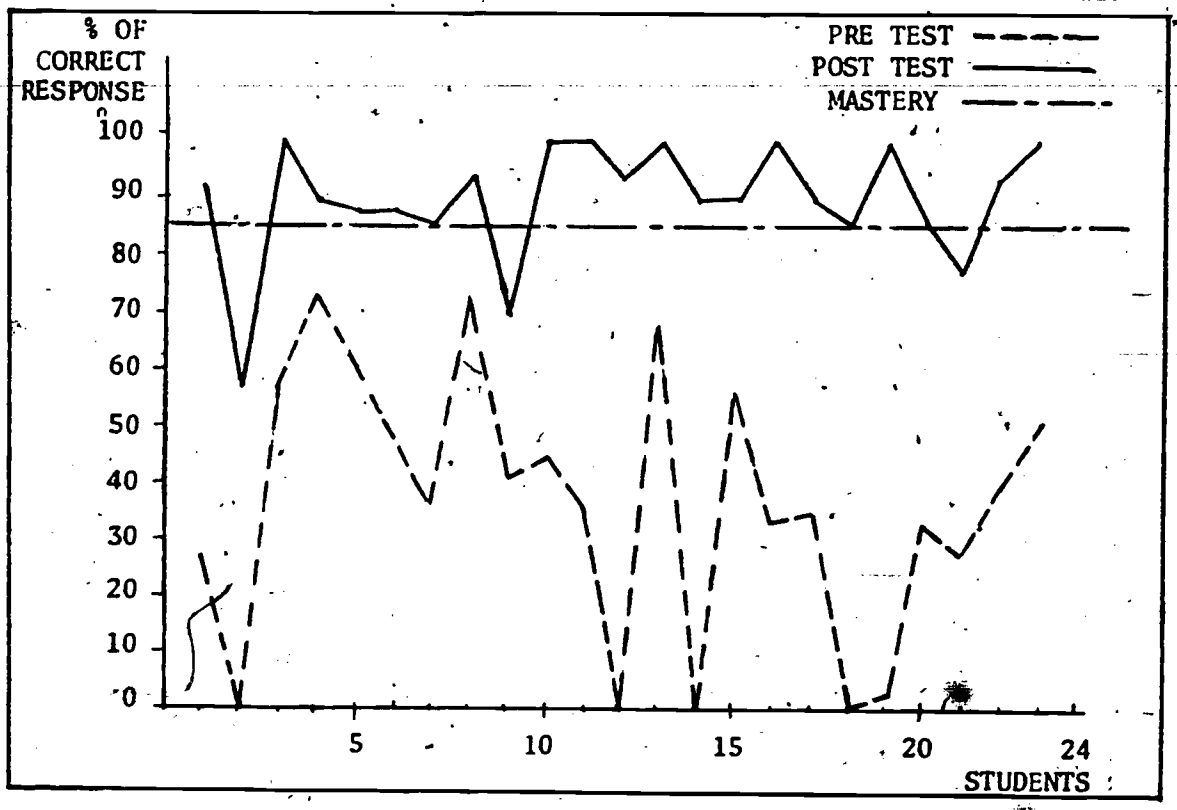



FIG 1: Percentage of correct responses on criterion test (Experimental group)

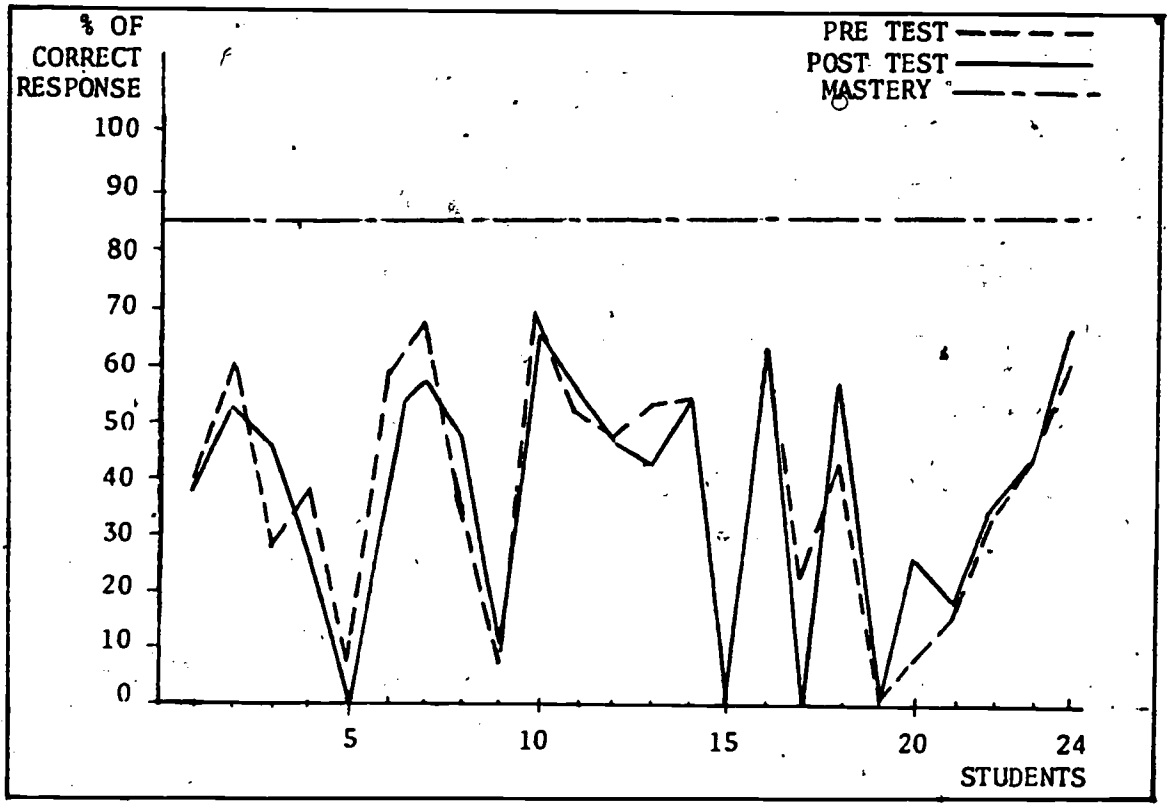



FIG 2: Percentage of correct responses on criterion test (Control group)

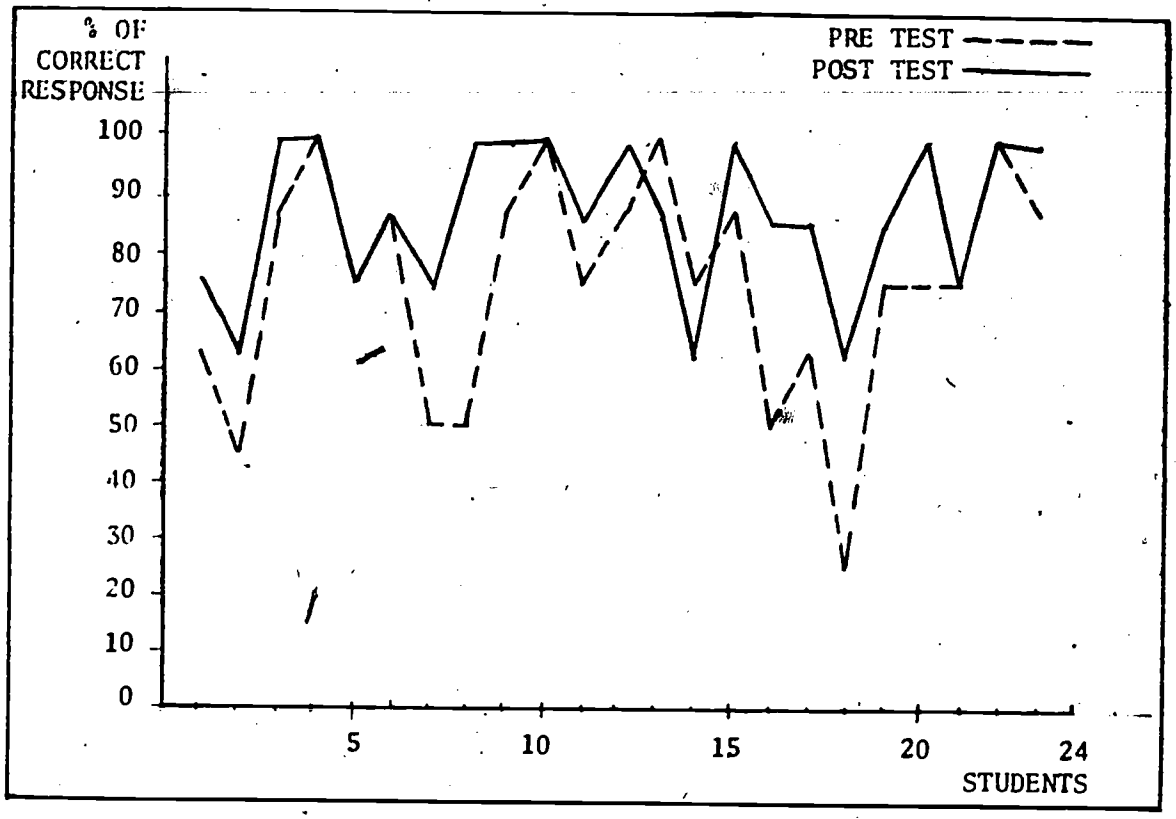



FIG 3: Percentage of correct responses on standardized test (Experimental group)

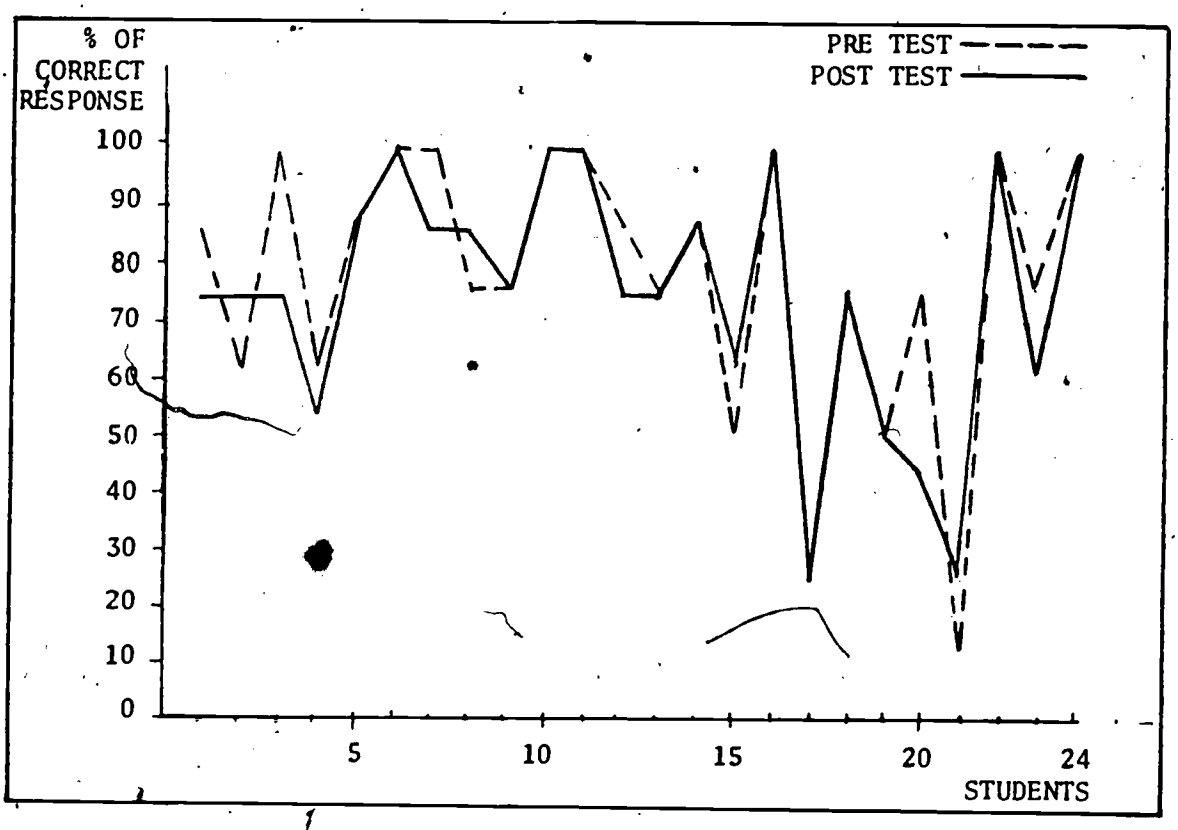



FIG 4: Percentage of correct responses on standardized test (Control group)

Discussion

This study was addressed to the following questions:

1. Whether it is possible to build a question asking set in children.

2. Whether the acquisition of a question asking set will enhance reading comprehension.

The first question can only be partially answered. The programmed instructional materials developed in this study trained children in generating the who, when, where, what, how, and why questions falling in the "verbatim questions" class. The significant gains of all the experimental groups indicate that it is possible to train children to generate "verbatim questions". However, further work is needed to develop instructional materials which will deal with the other classes of questions before the first question can be fully answered.

The results of this study support the contention that programmed instructional materials are an efficient and effective method for teaching students to generate "verbatim questions". The significant gains of all the experimental groups show that the students benefited from the programmed instructional materials.

The significant gains on the standardized subtest indicate that training in "question generating" can enhance comprehension. In order to correctly respond to the standardized subtest, the student had to generate questions at various levels of complexity (e.g. paraphrase, intersentence questions). The fact that the performance of the experimental groups on the standardized subtest improved significantly may be important; it could be interpreted to mean that, since the children were trained to respond at a lower level, they were capable of responding, spontaneously, to the constraints of higher level skills. This point should be verified with larger groups of subjects.

The instructional materials developed by the investigator proved to benefit children with varying entering skills. As evident from the summary tables (pp. 54-56), significant gains have been attained by children who scored 0 points on the criterion pre-test as well as by children scoring up to 44 points.

These gains suggest that the question generating program can be effectively used

1. as supplemental materials for the teaching of reading in regular classroom.

2. as a remediation method.

The question technique as derived from the analysis of reading as information processing has been used successfully with college students (Brethower, 1971). However, not enough work was done to verify the effectiveness of the method with elementary school children. The success of the question generating program suggests that the method can be applied to the teaching of reading in elementary schools. Indeed, there is a need to ascertain the value of the technique at various age-grade levels.

In summary, the following aspects should be further explored:

1. Development of instructional programs dealing with generation of higher level questions.
2. Development of instructional materials dealing with other aspects of the reading process (e.g. generation of alternatives).
3. Verification of the value of the questioning technique at various age-grade levels.

# APPENDIX A

The Pre- and Post-Test

a. The Criterion Subtest, pp. 60-62
b. The Standardized Subtest, pp. 63-65

Write two good questions for story A.

A.

John and Ann live by a lake. John and Ann have their own small boat. They like to row the boat on the lake.

1. _____

_____

2. _____

_____

_____

Do B - E the same way.

_____

B.

Joe has a dog his name is Charlie. This dog can do tricks. He can stand on his hind legs. When Joe throws a stick, Charlie runs and brings it back.

1. _____

_____

2. _____

_____

C.

A man was carrying a heavy box on his back. He could not climb a hill. The box was too heavy. Two boys came along and helped the man carry the box up the hill.

1. _____

_____

2. _____

_____

D.

David and John went fishing. David caught a big fish. John caught an old shoe that was in the lake. This made the boys laugh.

1. _____

_____

2. _____

_____

E.

Sandy likes to help her mother. After dinner she puts the dishes in the sink and washes them with soap and water. Then, she cleans the table and sweeps the floor.

1. _____

_____

2. _____

_____

62

Read Story A. and circle the words that answer the two questions.

A.

Billy had something.

Ann said, "What do you have?"

"It is a boat," said Billy.

1. Billy had a _____.

here ball boat said

2. "What do you have?" said _____.

what Billy Jane Ann

Do B - E the same way.

B.

Tim lives on a farm. He sells his milk to the dairy. The dairy puts the milk into bottles and sells it in town.

1. Tim sells milk to the _____.

bottles dairy farm cows

2. Tim lives on a _____.

barn dairy town farm

C.

Some men sail far out to sea in little boats and let down their nets. When they pull up the nets, they have thousands of tiny sardines. It is bad to catch too much because the net breaks.

1. Sardines are caught by _____.

boxes nets traps hooks

2. Too many fish make the nets _____.

break stop drop slide

D.

Both sides of the big canyon were coverd with trees. The stream at the bottom of the canyon looked small. It was really a large stream. It was just far away.

1. The canyon had trees on two _____.

miles sides streams lakes

2. The stream was _____.

big small slow blue

E.

One night a policeman found a little boy with a dog. "Where do you live, young man?" asked the policeman. The boy would not talk. Then the policeman noticed a tag on the dog's collar. "Frisky, 2153 First Street," read the tag.

1. The policeman probably took the boy _____.

home downtown to school to church

2. Frisky was the name of the _____.

dog street girl policeman

# APPENDIX B

Sample Pages from Fourth
Draft of Question Generating Program

Lesson 1, Page 1a; the general rule

A question always ends with a question mark.

Lesson 1, Page 1

Read A then, circle the question

A.

1. Who wrote this book?
2. This is a funny story.

Yes, (1) is a question because it ends with a question mark.

Do B - P the same way.

B.

1. How old is Tim?
2. I have two brothers.

C.

1. Jim likes to eat candy.
2. What are you eating?

-1-

## Lesson 8: self-check answer sheet

Lesson 8

Check your questions.

Put a ✓ in the boxes below

If the question:

1. Ends with a ?
2. Starts with a ? word.
3. Is answered by the story

| | ? | ? word | is it answered by the story? |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |



## Lesson 1: fold out answer sheet

Lesson 1

Page 1

A.
B.
C.

Page 2

D.
E.
F.
G.

Page 3

H.
I.
J.
K.
L.

Page 4

O.
P.

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